ATTACHMENT 6. MONITORING, ASSESSMENT, AND PERFORMANCE MEASURES

PURPOSE OF PROJECT

The Water Supply Stabilization Project No. 2 (WSSP2) is a groundwater basin banking project that will increase the reliability of the Antelope Valley Region's water supplies through recharge and recovery of State Water Project water supplies. The purpose of the WSSP2 is to recharge and store SWP water in the groundwater basin when water is available and recover the stored water as needed. The WSSP will reduce the Antelope Valley Region's critical dependence on water deliveries from the Delta and reduce over-drafting of the groundwater basin.

INFORMATION SOURCE USED TO PREPARE THIS ATTACHMENT

A report prepared by the USGS, entitled Assessing the Feasibility of Artificial Recharge and Storage and the Effectiveness and Sustainability of Insitu Arsenic Removal in the North Buttes Area of the Antelope Valley prepared in 2010 was the source of the information given below. (A copy of the USGS report is included as File 2 of Attachment 3.)

MONITORING AND ASSESSMENT GUIDANCE

Expected Recharge Rate

The Antelope Valley is a sediment filled depression between the Garlock Fault on the North and the San Andreas Fault on the South. The groundwater basin has been divided into 12 sub-basins. The recharge basins to be constructed as part of WSSP2 will be located in the northwestern part of the Lancaster Sub-basin of the Antelope Valley which is the largest of the 12 sub-basins.

At the proposed recharge pond site, the ground surface slopes down gradient to the east across the recharge pond site from about elevation 2570 feet to elevation 2530 feet. The depth to groundwater, as measured by the USGS, was about 240 feet on the west and 270 feet on the east. This information places the groundwater surface elevations at about 2330 feet on the west side and 2260 feet on the east side of the recharge basins.

Historical records indicate that the groundwater level has declined about 100 feet in the vicinity of the recharge basins since the 1960s.

A USGS model was used to estimate the recharge rate and the changes in groundwater elevation during recharge. The model predicted that about 23,000 AF could be percolated into the underlying groundwater basin over the planned four months per year recharge cycle (November through February). The recharge pond area used in the modeling effort was 385 acres. The proposed gross recharge pond area is about 400 acres with a net percolation area of about 385 acres.

Back-calculating indicates that the average percolation rate over the 120 days in the four month recharge cycle is about six inches per day. Reported percolation rates for the soils at the recharge basin sites exceed two feet per day.

Direction of Groundwater Movement

The groundwater movement is generally from west to east as would be expected considering the groundwater surface on the east side of the recharge basins is about 70 feet lower than the groundwater elevation on the west side of the basins.

Expected Changes in Groundwater Surface Elevation

The USGS model was also used to predict changes in groundwater elevation resulting from the recharge project. The following data was input to the model:

1. Recharge four months per year (November through February) for five years;
2. Recharge rate = 28,500 AFY;
3. Total recharged over five years = 142,500 AF.

The computer model predicted increases in groundwater elevation after five years were as follows:

1. 230 feet at the center of the recharge basins;
2. 50 feet within one mile of the recharge basins; and,
3. 10 feet within four miles of the recharge basins.

Water Quality

Based on water analyses on samples taken from existing agricultural wells at the recharge site, the native groundwater is generally of potable quality. The Total Dissolved Solids (TDS) concentration was found to range from about 260 to 400 mg/L. Nitrate concentrations were found to be less than one-half of the MCL for drinking water. Some arsenic was found on the western and northeastern edges of the site. It should be noted that the “site” covers about 1500 acres and the recharge basins will cover about 400 acres some distance from the areas where arsenic was found.

Expected Recovery

It is planned to recharge an average of 23,000 AFY. It is expected that about 90% of the water recharged will be recovered.

Existing Monitoring Wells

The USGS constructed three monitoring wells using the Overburden Drilling and Exploration (ODEX) technique on the project site as part of their investigative study. The wells were drilled to the water table to allow instrument installation throughout the unsaturated zone and at the water table. Cores were preserved on site to prevent changes in water content and water potential. A gamma log and a neutron log were collected from within the ODEX pipe after drilling was completed. These logs were used with lithologic and specific conductance data from drill cuttings to guide placement of instruments within the borehole.

A water-table well, advanced tensiometers, temperature sensors, dielectric permittivity sensors, and suction-cup lysimeters were installed in the completed boreholes. The well at each site will be used to measure changes in water levels and groundwater quality resulting from recharge and also will serve as an access for an electromagnetic (EM) resistivity geophysical tool used to monitor the downward movement of water during recharge. Advanced tensiometers are used to measure matric potential and

pressure head at depths in the unsaturated zone where perched water may accumulate during artificial recharge. Dielectric permittivity sensors and temperature sensors are used to measure matric potential and temperature in the unsaturated zone. These sensors are commonly placed in coarse-grained deposits or beneath layers expected to impede the downward movement of water. Suction-cup lysimeters are used to collect water samples from the unsaturated zone for laboratory analysis. Instruments were installed at depths determined on the basis of lithologic and geophysical-log data collected during drilling. Each instrument was installed in backfill material intended to ensure adequate contact with the surrounding unsaturated materials. Instruments were separated by low permeability bentonite grout to ensure water does not move vertically through the borehole. These instruments are controlled and data recorded using a data logger installed in a vault at land surface.

Data will be collected from the advanced tensiometers, temperature sensors, and dielectric permittivity sensors in the unsaturated zone at 4-hour intervals. Data collected from the instruments will be stored in data loggers and retrieved at approximately 6-week intervals. Water samples from the piezometers will be collected when data are retrieved from the data loggers and analyzed to determine differences in water quality with depth.

In addition to these three ODEX wells, AVEK will utilize five existing irrigation wells on the 1,500 acre site to monitor groundwater levels and water quality.

PERFORMANCE MEASURES

The following measurements will be made to determine performance:

1. Volumes of water delivered to recharge basins will be measured by meters installed on the turnouts into the recharge basins from AVEK's existing West Feeder. AVEK anticipates delivering up to 23,000 acre-feet of water per year.
2. Infiltration rates of water placed into the recharge basins will be measured using the EM resistivity geophysical tool and temperature gages. The anticipated average infiltration rate is 0.5 feet per day.
3. Changes in water chemistry during recharge as constituents are adsorbed or absorbed in the soil column or dissolved from the soil during recharge will be monitored using the suction cup lysimeters and water samples collected from the piezometers. AVEK anticipates that the soil column in the unsaturated zone will provide sufficient filtering for the recharged surface water that it will meet or exceed all drinking water standards by the time it reaches the groundwater table. AVEK also anticipates that the concentration of any constituents dissolved from the soil column during recharge will also remain below all drinking water standards.
4. Rates and volumes of water pumped from recovery wells will be measured by meters installed on the discharge piping from each well.
5. Groundwater surface elevations will be measured using five existing agricultural water and two monitoring wells constructed by USGS during the course of their study. In addition, the USGS has an on-going program of measuring the depth to ground water on wells throughout the Antelope Valley. Monitoring groundwater levels is also included in the Antelope Valley East Kern Water Agency WSSP-2: Groundwater Recharge Project, Mitigated Negative Declaration (SCH# 200807013), Mitigation Monitoring and Reporting Program prepared by AVEK, dated August 2008. ((A copy of this document is included as File 7 of Attachment 3.) AVEK anticipates that groundwater levels will rise as described above as a result of the project.
6. Quality of the recovered water will be ascertained by taking and analyzing samples from each of the recovery wells per California Title 22 drinking water regulations.

7. Quality of the SWP water delivered to the recharge basins will be measured under AVEK's existing SWP water quality sampling/analytical program (AVEK owns and operates four water treatment plants that treat SWP water).

The parameters which will indicate the success of the Project include:

1. Measured volumes of water recharged with a goal of at least 23,000 AF over the four month recharge period (November through February).
2. The volume of water recovered via the recovery wells with a goal of recovering 90% of the volume of water recharged.
3. Changes in groundwater levels under the property with a goal of an increase in the groundwater table which is consistent with the findings of the USGS Study. .
4. The quality of recovered water with a goal to meet all drinking water standards.
5. Infiltration rates of recharged water with a goal of at least a half a foot per day during periods of recharge.